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(54) Title: APPARATUS FOR MONITORING AND CONTROLLING FUEL DELIVERY AND METHODS OF MONITORING AND CONTROLLING SAME

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(57) Abstract: A system and associated methods for monitoring fluid distribution for heavy duty vehicles are provided. The system advantageously includes a first handheld RF data communications terminal. The handheld data terminal preferably includes a portable housing readily adapted to be positioned in the hand of a driver of a heavy duty vehicle and a first RF transceiver connected to the portable housing for transmitting and receiving RF data communications to thereby interface with a heavy duty vehicle driver to collect data from customer fluid delivery locations. The system also includes at least one heavy duty vehicle adapted to transport fluid and a second vehicle data communications terminal preferably mounted to the at least one heavy duty vehicle. The second data communications terminal preferably includes a second RF transceiver for transmitting and receiving RF data communications. The system additionally includes at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle. The fluid storage tank includes a tank identifier for identifying the tank and adapted to be received by the data collection device of the first handheld data collection terminal. The system further includes a main office data monitoring and dispatching data terminal is associated with a main office. The main office data terminal preferably includes a third RF transceiver for transmitting and receiving data communications to and from the vehicle data communication terminal to thereby provide dispatching instructions from a main office user to the heavy duty vehicle and the vehicle driver.

**APPARATUS FOR MONITORING AND CONTROLLING FUEL  
DELIVERY AND METHODS OF MONITORING  
AND CONTROLLING SAME**

**Related Applications**

This application is a continuation-in-part of co-pending U.S. Patent Application Serial No. 09/503,999 filed on February 14, 2000, which is a continuation of co-pending U.S. Patent Application Serial No. 08/954,315 filed 5 on October 17, 1997 which is a continuation-in-part of U.S. Patent Application Serial No. 08/840,571 which is now U.S. Patent No. 5,902,938 and which is hereby incorporated herein by reference in its entirety.

**Field Of The Invention**

This invention relates to the fuel delivery industry and, more particularly 10 to the fuel monitoring and control systems and methods for the fuel delivery industry.

**Background Of the Invention**

Over the years, technology has been slow to develop for heavy duty vehicles for various reasons. For example, much of the technology involves 15 heavy mechanical systems which can be difficult to translate to electronic software based systems. Also, there have been little or no standards in electronic systems for these types of vehicles. Further, many of these heavy duty vehicles include tractor/trailer-type vehicles or trucks which often involve an owner who owns a fleet of these vehicles. Accordingly, because these

vehicles are often already on the road or in use, it can be expensive and difficult to retrofit existing vehicles. Meanwhile, manufacturers of new vehicles also are hesitant to install advanced equipment because of the expense and the fear of acceptance by drivers and others in the industry.

5        Nevertheless, some data communications standards for heavy duty vehicles have arisen over the years, such as Society of Automotive Engineering ("SAE") standard J1708 and SAE standard J1939. Accordingly, more and more electronic and software systems are slowly being accepted. The fluid distribution industry, however, has been even more slow to accept

10      these technology changes. For example, not only for the reasons set forth above exist, but these industries also often involve potentially dangerous or explosive materials, e.g., petroleum based fuels, which emit fumes that can readily ignite if an electrical spark or other type of spark initiates surrounding fumes.

15      Some data communications systems for heavy duty vehicles that have been adopted include built in data communication terminals mounted in the cab of heavy duty tractor trailer vehicles. Examples of such systems can be seen in U.S. Patent No. 4,313,168 by Stephens et al. titled "*Fluid Register System*," U.S. Patent No. 5,204,819 by Ryan titled "*Fluid Delivery Control Apparatus*," and U.S. Patent No. 5,359,522 by Ryan titled "*Fluid Delivery Control Apparatus*." These prior patents, however, fail to appreciate the need for systematic monitoring and controlling of fuel distribution and data communications for such distribution and fail to appreciate the need for careful handling of such data communication systems especially in potentially

20      explosive or environmentally hazardous fluid distribution environments. Further, these prior systems also fail to appreciate driver constraints when receiving instructions for deliveries, making deliveries, and loading and unloading fluid at various delivery and receiving sites.

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### Summary of the Invention

In view of the foregoing, the present invention advantageously provides

a fluid monitoring and distribution apparatus for monitoring fluid distribution in heavy duty vehicles. The present invention also advantageously provides fluid monitoring and distribution and associated methods which provide data communication through data links which inhibit potentially explosive

5       electronics being mounted in explosive sensitive areas of a vehicle and fluid metering systems. The present invention additionally provides a readily portable data communication terminal for a driver which allows the driver to walk among the potentially explosive environment with little fear of explosive potential being initiated from the data communication terminal and yet

10      provides effective data communication between the driver, the heavy duty vehicle, fluid delivery location, and a main dispatching office. The present invention further advantageously provides an effective fluid delivery tracking and monitoring system which can be readily installed and retrofitted into existing vehicles and can also be initially installed on new vehicles in a cost

15      effective manner.

More particularly, a system and associated methods for monitoring fluid distribution for heavy duty vehicles are provided. The system advantageously includes a first handheld RF data communications terminal. The handheld RF data terminal preferably includes a portable housing readily

20      adapted to be positioned in the hand of a driver of a heavy duty vehicle and a first RF transceiver connected to the portable housing for transmitting and receiving RF data communications to thereby interface with a heavy duty vehicle driver to collect data from customer fluid delivery locations. The system also includes at least one heavy duty vehicle adapted to transport fluid

25      and a second vehicle data communications terminal preferably mounted to the at least one heavy duty vehicle. The second data communications terminal preferably includes a second RF transceiver for transmitting and receiving RF data communications. The system additionally includes at least one fluid storage tank positioned at a customer fluid delivery location for

30      receiving and storing fluid transported by the heavy duty vehicle. The fluid storage tank preferably includes RF tank identifying means for identifying the tank and adapted to be received by the data collection device of the first

handheld data collection terminal. The system further includes a main office data monitoring and dispatching data terminal associated with a main office. The main office data terminal preferably includes a third RF transceiver for transmitting and receiving data communications to and from the vehicle data communication terminal to thereby provide dispatching instructions from a main office user to the heavy duty vehicle and the vehicle driver.

According to another aspect of the present invention, a system for monitoring fluid distribution for a fleet of heavy duty vehicles adapted to transport fluid is provided. The system preferably includes a plurality of first handheld RF data communications terminals. Each of the plurality of handheld terminals includes a portable housing readily adapted to be positioned in the hand of a driver of a heavy duty vehicle, a first RF transceiver connected to the portable housing for transmitting and receiving RF data communications, a first processor mounted in the housing for processing data communications, a first user interface connected to the processor and to an external surface of the portable housing for interfacing with a heavy duty vehicle driver, and an RF data collection device connected to the processor and to the portable housing for collecting data from customer fluid delivery locations.

The system also includes a fleet of heavy duty vehicles adapted to transport fluid and a plurality of second vehicle data communications terminals each mounted to one of the fleet of heavy duty vehicles. Each of the plurality of second vehicle data communications terminals preferably includes a second RF transceiver for transmitting and receiving RF data communications, a second processor for processing data communications, and a second user interface for interfacing with a driver of a heavy duty vehicle.

The system additionally preferably includes at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle. The fluid storage tank preferably includes RF tank identifying means for identifying the tank and adapted to be received by the data collection device of each of the plurality of first handheld

data collection terminals.

The system further preferably includes a main office data monitoring and dispatching terminal associated with a main office for monitoring and dispatching fuel distribution data to the fleet of heavy duty vehicles. The main office terminal preferably includes a third RF transceiver for transmitting and receiving data communications to and from each of the plurality of second vehicle data communication terminals, a third processor connected to the third RF transceiver for processing data communications, and a third user monitoring and dispatching interface for monitoring fluid distribution data and for providing dispatching instructions from a main office user.

The present invention also advantageously includes methods of monitoring and distributing fluid to customers. A method of monitoring fluid distribution for heavy duty vehicles preferably includes providing a first handheld RF data communications terminal. The first handheld RF data communications terminal includes a first RF transceiver for transmitting and receiving data communications and an RF data collection device for collecting data from customer fluid delivery locations. The method also includes providing a second vehicle data communications terminal mounted to the at least one heavy duty vehicle. Each of the second data communications terminals includes a second RF transceiver for transmitting and receiving RF data communications. The method additionally includes providing at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle. The fluid storage tank preferably includes an RF tank identifier for identifying the tank and adapted to be received by the RF data collection device of the first handheld data collection terminal. The method further includes providing a main office data monitoring and dispatching terminal associated with a main office for monitoring and dispatching fuel distribution data to the at least one heavy duty vehicles. The main office terminal includes a third RF transceiver for transmitting and receiving data communications to and from the vehicle data communication terminal.

Another method of monitoring fluid distribution for heavy duty vehicles

preferably includes collecting tank identifying data from at least one fluid storage tank positioned at a customer fluid delivery location with a handheld RF data communications terminal, transmitting the tank identifying data to a vehicle RF data communications terminal mounted to a heavy duty vehicle

5      adapted to transport fluid thereon, and transmitting the tank identifying data from the vehicle data communications terminal to a main office monitoring and dispatching terminal. The main office monitoring and dispatching terminal preferably includes an RF data communications transceiver associated therewith for transmitting and receiving RF data communications.

10     Yet another method of monitoring fluid distribution for heavy duty vehicles preferably includes providing at least one fluid storage tank at a customer fluid delivery location. The at least one fluid storage tank includes a tank meter for metering fluid flowing to and from the tank and an RF transceiver associated with the at least one tank and responsive to the tank

15     meter. The method also includes transmitting metering data from the RF transceiver to a handheld RF data communications terminal, transmitting metering data from the handheld RF data communications terminal to a vehicle RF data communications terminal mounted to a heavy duty vehicle adapted to transport fluid thereon, and transmitting metering data from the

20     vehicle RF data communications terminal to a main office monitoring and dispatching terminal. The main office monitoring and dispatching terminal preferably includes an RF data communications transceiver associated therewith for transmitting and receiving data communications.

#### Brief Description of the Drawings

Some of the features, advantages, and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings in

5      which:

FIG. 1 is a top environmental view of a fuel delivery system being used to monitor and control fuel delivery according to the present invention;

FIG. 2 is a side elevational view of a fuel delivery system for monitoring and controlling fuel delivery according to the present invention;

5 FIG. 3 is a perspective view of a fuel delivery system having a remote communication device for monitoring and controlling fuel delivery according to the present invention;

FIG. 4 is a front elevational view of a remote communication device for monitoring and controlling fuel delivery in a fuel delivery system according to  
10 the present invention;

FIG. 5 is a perspective view of a meter block and wheel of a fuel delivery system for monitoring and controlling fuel delivery according to the present invention;

15 FIG. 6 is a fragmentary side elevational view of a meter block and wheel of a fuel monitoring and controlling fuel delivery according to the present invention;

FIG. 7 is an exploded perspective view of a meter block and wheel of a fuel delivery system for monitoring and controlling fuel delivery according to the present invention;

20 FIGS. 8 and 8A are perspective views of a fuel delivery system for monitoring and controlling fuel delivery having a fuel tank identification, metering and monitoring apparatus according to a first embodiment of the present invention;

25 FIG. 8B is a perspective view of a fuel delivery system for monitoring and controlling fuel delivery having a fuel tank identification, metering and monitoring apparatus according to a second embodiment of the present invention;

FIG. 9A-9C are flow diagrams of methods for monitoring and controlling fuel delivery according to the present invention;

30 FIG. 10 is a perspective view of an emergency control apparatus of a system for monitoring and controlling fuel delivery according to the present invention; and

FIG. 11 is a flow diagram of a method for controlling a fuel delivery system in the event of an emergency situation according to the present invention.

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#### Detailed Description Of Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated 10 embodiments set forth herein. Rather, these illustrated embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime, double prime, and triple prime 15 notation, where used, generally indicate similar elements in alternative embodiments.

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FIG. 1 illustrates an environmental view of a fuel delivery system 20 being used in conjunction with one or more heavy duty vehicles 15, e.g., a fleet, a fuel delivery tank 40, and a main monitoring station 50 which monitors and dispatches the heavy duty vehicles for fuel delivery. Each of the heavy 20 duty vehicles 15 is preferably a tractor 16 coupled to a trailer 18 having one or more fluid, e.g., petroleum based fuel storage tanks 19 mounted to the trailer 18. As understood by those skilled in the art, however, various other types of heavy duty vehicles which temporarily store and transport fluid can be used as well according to the present invention.

25

The system 20 preferably includes a fleet of heavy duty vehicles 15 each of which are adapted to transport fluid. As described above, the fleet of vehicles 15 is preferably provided by a plurality, e.g., two or more, of tractor/trailer combination vehicles or fluid distribution trucks as understood by those skilled in the art. The fleet of heavy duty vehicles 15 preferably also 30 has a plurality of vehicle data communications terminals 30 each mounted to one of the heavy duty vehicles 15 of the fleet (see FIGS. 1 and 2). Each of the vehicle data communications terminals 30 includes an RF transceiver 32

for transmitting and receiving RF data communications and a processor 33 for processing data communications. The RF transceiver 32 also includes an antenna 34. The vehicle data communications terminals 30 also include a user interface 35, e.g., a keyboard and/or a display (not shown), preferably positioned for interfacing with a driver D of a heavy duty vehicle 15 when the driver D is positioned in the cab of the tractor 16.

As perhaps best shown in FIGS. 3-4, the fuel delivery system 20 preferably includes one or more, e.g., a plurality, of remote handheld data communications terminals or remote communication devices 22 which are each preferably in the form of a hand held radio frequency ("RF") communication device. The remote communication device 22 also preferably has a user interface 23 which includes a keyboard 24, sensors, or other portion of the system which provides feedback in response to the user U and a display 25 for viewing information by the user U. The remote communication device 22 also preferably includes a micro-reader, e.g., an RF communication controller, such as RI-STU-MRD1 supplied by Texas Instrument (the specification of which is incorporated herein by reference in its entirety), which is connected to a serial or other port of the remote communication device 22. The device 22 preferably has a scan control switch or button as a portion of the user interface 23. The scan control switch is preferably connected to a de-bounce circuit as understood by those skilled in the art. The de-bounce circuit is preferably connected to a trigger input of the remote communication device 22. Two loop antennae 13, each tuned to half of the total required inductance, are attached in series to the antenna output of the micro-reader. The antennae are mounted inside the handheld housing enclosure, protecting them from environmental damage. The user is able to scan a passive RFID transponder from either side of the handheld communication device which advantageously allows easy left and right hand operation.

Each of the remote communication devices or handheld data communications terminals 22 further includes a portable housing 21 readily adapted to be positioned in the hand of a driver D of a heavy duty vehicle 15.

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Each handheld data terminal 22 also preferably includes a first RF transceiver 27 connected to the portable housing 21 for transmitting and receiving RF data communications. The first RF transceiver 22 preferably includes an antenna 26 mounted to an external surface of the portable housing 21.

5 Except as described above, the internal operation of the handheld RF device is similar to that shown in co-pending U.S. Patent Application Serial No. 09/503,999 which is incorporated herein in its entirety and for brevity is not further described herein. A first processor is mounted in the portable housing 21 for processing data communications transmitted and received by the first

10 10 RF transceiver 22. The user interface 23 is also preferably connected to the first processor and to an external surface of the portable housing 21, as illustrated, for interfacing with a user such as a heavy duty vehicle driver.

The handheld data communications terminal 22 also advantageously includes an RF data collection device, e.g., antennae and RF micro-reader 15 connected to the processor and to the portable housing 21 for collecting data from customer fluid delivery locations. The data collection device can be provided by a bar code reader as illustrated in one of the parent applications to this present application, but is more preferably a non-contacting communication device such an RF micro-reader as described above which 20 scans or detects an RFID (radio frequency identification device) transponder 42.

The RFID transponder 42 is preferably mounted to a fluid delivery tank 40 as illustrated and is preferably provided by a transponder 42 such as the Texas Instruments RI-TRP-R9QL as understood by those skilled in the art. 25 To scan the RFID transponder 42, a side of the handheld data collection terminal 22 is placed within a predetermined range, e.g., about 0.5 to 5 inches and, more preferably, about 4 inches, of the transponder 42 attached to the tank which the RF terminal 22 is trying to identify. The scan button or switch 30 on the user interface 23 is pressed and released. On the release, the RF micro-reader of the handheld device 22 transmits a 50 millisecond radio pulse to the transponder 42. The transponder then uses the RF energy to energize its own circuitry, and then transmits a unique 20-digit code or serial number

using a predetermined protocol. The micro-reader reads the 20-digit code, and transmits it in a packet to the microprocessor 28 of the micro-reader through the serial interface described above.

When a customer is assigned to a specific truck/driver combination, a

5 list of the tanks or vehicles to be delivered is sent by the central or main office system to the truck system over a radio frequency network. For each tank or vehicle, there is one record in the list. Each record, for example, can advantageously include the following fields: the 20-digit RFID code, a customer ticket number, product abbreviation, whether fluid is to be metered

10 or not, the volume delivered (gallons, litres, etc.), the price per gallon (currency), the tax per gallon (currency), the freight per gallon (currency), the tank odometer and/or hour reading, the tank fixed fees (currency), the tank capacity (volume), the name of the tank, the date of delivery, the time of delivery, where or not it has been delivered, whether this is to be measured

15 as net or gross gallons, meter type, shape of tank, the orientation of the tank, how the tank was identified (hand keyed, RFID scanned, other), validity of the record. When the user arrives at a customer site, he selects that customer from a list displayed on the handheld computer. He is prompted to enter the totalizer readings from each of the registers on the mechanical meters. When

20 this is done, the list of tanks or vehicles associated with that customer is sent from the on board storage in the truck unit to the handheld data communication device 22.

The user is then prompted to scan the first tank or vehicle that he is to fill. The user then places the handheld device in the vicinity of the RFID transponder as described above that is attached to the tank or vehicle, and then presses the scan button. If the RFID reader receives a valid response from the transponder, the RFID system delivers the 20 digit code to the application running on the microprocessor of the handheld device. The application then accepts the 20-digit code and searches for the same code in the list that was loaded when first arriving at the customer site.

30 If a match is found, the system checks to see if the compartment containing the product matching the product abbreviation field is open. If all

compartments are closed, then the user is prompted to open the compartment containing the matching product type. If the wrong compartment is open, the user is prompted to close that compartment and open the correct one. Once the proper compartment is opened, the data 5 associated with the tank or vehicle is then displayed to the driver on the handheld screen. He is able to read the name of the tank or vehicle, the product type, the capacity of the tank, and the number of gallons pumped so far. When the tank or vehicle is filled, the driver records the transaction by pressing an enter key on the handheld device.

10 At this time, the quantity delivered field is populated with the volume pumped into the tank, the date of delivery and time of delivery fields are populated with the current data and time, the meter reading field is populated with the odometer or hour meter reading, if appropriate, the entry method field is set to "scanned", and the valid and delivered fields are set to "true." This 15 information is then stored in the truck unit for later transmission to the main office system over the RF network.

If a match between the scanned code and the codes listed in the database is not found, the user is notified that the RFID transponder is not recognized. He is then given the opportunity to manually identify the tank or vehicle, manually select the fuel type, and then deliver to the tank or vehicle. 20 The system will then create a new record containing all of this information. The record is flagged as an exception, and reported as such when the information is transmitted back to the office system over the RF network.

When the transaction data is sent back to the office system over the 25 RF network, it is stored in a relational database. This database contains extended fields not contained in the truck database. An ISO card number can be stored and related to each RFID serial code, allowing a transaction for each tank or vehicle to be billed directly to a credit card, fleet card, or other proprietary card system.

30 The system 20 also preferably includes at least one fluid storage tank 40, e.g., a bulk storage tank positioned above or below ground, positioned at a customer fluid delivery location for receiving and storing fluid transported by

a heavy duty vehicle 15. The fluid storage tank 40 preferably includes a RF transceiver 43 or RFID transponder as described above for transmitting and receiving data communications. In an alternative embodiment, the RF transceiver can include an antenna associated therewith, tank identifying 5 means, e.g., an identifier for identifying the tank 40 and adapted to be received by the data collection device 29 of the handheld data collection terminal 22. The tank identifying means can include customer information along with the tank identification.

As best illustrated in FIG. 1, the system 20 further preferably includes 10 a main office data monitoring and dispatching terminal associated with a main office 50 for monitoring and dispatching fuel distribution data to the fleet or the plurality of heavy duty vehicles 15. The main office terminal is also described in more detail in co-pending U.S. Patent Application Serial No. 09/503,999. The main office data monitoring and dispatching terminal preferably includes 15 a third RF transceiver for transmitting and receiving data communications to and from each of the plurality of vehicle data communication terminals 30. The third RF transceiver also preferably includes an antenna associated therewith. The main office data terminal also preferably includes a third processor connected to the third RF transceiver for processing data 20 communications, and a third user monitoring and dispatching interface for monitoring fluid distribution data and for providing dispatching instructions from a user.

As perhaps best illustrated in FIGS. 2, 8A-8B, and 10, according to other aspects of the present invention, the second processor 33 of each of 25 the plurality of second vehicle data communications terminals 30 is preferably provided by a central processor, a central processing unit ("CPU"), a microprocessor, or other processing circuits as understood by those skilled in the art. Each of the plurality of second vehicle data communications terminals 30 further includes data storing means 36 in communication with the 30 second RF transceiver 32 for storing data and a printer 39 connected to the CPU 33 for printing data (see FIG. 1).

Each of the second vehicle data communication terminals 30 further

includes a twisted pair data communications network 51 and data communications protecting means 55 connected to the twisted pair data communications network 51 for providing protective data communications in potentially explosive environments from the twisted pair network 51 to at least one valve 57 and/or at least one meter 58 associated with the heavy duty vehicle 15 to which the second vehicle data communications terminal is mounted. The data communications protecting means 55 is preferably provided by a fiber optics data communications module. The fiber optic data communications module 55 advantageously includes at least one light emitter 10 for emitting optical metering data and at least one light receiver for receiving the optical metering data. The fiber optic data communications module 55 can be as shown and described in more detail in co-pending U.S. patent application Serial No. 08/840,571 filed on April 21, 1997 and which is incorporated herein by reference in its entirety. Accordingly, for brevity and 15 conciseness, the fiber optic data communications module is not further described herein. As understood by those skilled in the art, other immune or explosive inhibiting data communications protecting means 55 such as described and shown in FIGS. 5-7 of this U.S. patent application can be used as well according to the present invention and which is currently more 20 preferable.

The plurality of second vehicle data communications terminals 30 further include at least one fiber optic channel 52 connected to the fiber optic data communications module 55, at least one fluid delivery valve 57 connected to the at least one fiber optic channel, and at least one meter 58 connected to the at least one fiber optic channel 52. As illustrated in FIGS. 25 1 and 3-4, the at least one valve 57 can be a plurality of valves, e.g., 1 to n number of valves, and the at least one meter 58 can be a plurality of meters. The second processor 33 of each of the plurality of vehicle data communication terminals 30 also preferably includes odometer monitoring 30 means, e.g., an odometer input controller 61, for monitoring the odometer of the heavy duty vehicle, a power take off ("PTO") controlling means, e.g., a PTO input controller 62, for controlling power take off for the pump which

distributes fuel, engine controlling means, e.g., an engine output controller 63, for controlling the vehicle engine, temperature monitoring means, e.g., temperature input monitors 65, 66, for monitoring at least one system temperature, and horn controlling means, e.g., a horn controller 64, for controlling the horn of the vehicle.

5        Additionally, as illustrated in FIG. 1, the data communications protecting means 55 associated with each heavy duty vehicle 15 preferably provides only first data communications protecting means. The fluid storage tank 40 preferably further includes a fourth RF transceiver 42 and second 10 data communications protecting means 45 connected to the fourth RF transceiver 42 and at least one meter 48 for providing protective data communications between the fourth RF transceiver 42 and the at least one meter 48 in a potentially explosive environment. The second data 15 communications means 45 can also provide secure data communications to and from at least one valve 47 as well. The second data communications protecting means 45 can also be a fiber optic module such as illustrated and described in U.S. patent application Serial No. 08/840,571 filed on April 21, 1997, but more preferably is the one as described herein. The fiber optic module 45 preferably includes at least one optical emitter for emitting optical 20 metering data and at least one optical receiver responsive to the at least one optical emitter for receiving optical metering data.

Further, the third processor of the main office monitoring and dispatching terminal includes accounting means for accounting customer order data, the customer order data including fluid product-type pricing and 25 dispatching means for providing dispatching instruction data to a vehicle driver D. The dispatching means preferably includes trip delivery organizing means for organizing individual trips for predetermined ones of the fleet of heavy duty vehicles responsive to customer location, fluid product-type, and required delivery date to thereby define fleet routing instructions. The fleet 30 routing instructions, in turn, preferably include individual vehicle routing instructions. The individual routing instructions are transmitted from the third RF transceiver to the second RF transceiver of each of the plurality of vehicle

data communication terminals 30 and are transmitted from the second RF transceiver to the first RF transceiver of each of the plurality of first handheld data communications terminals 22.

The first processor 23 of each of the plurality of first handheld data communications terminals 22 also includes vehicle inspecting means responsive to the individual routing instructions for providing vehicle inspecting instructions to a vehicle driver D. The vehicle inspecting means is preferably provided by an interactive software program, as understood by those skilled in the art, which preferably includes the driver D answering a series of questions about the condition of all critical vehicle subsystems by 10 interfacing with the user interface 23 of the handheld RF data communications terminal 22 and the recording of the results by sending them to the data storing means of the vehicle data communications terminal 30. The vehicle inspecting instructions, in other words, are transmitted to the 15 vehicle data communications terminal 30 of a corresponding one of the fleet of heavy duty vehicles 15 responsive to the vehicle driver D.

The system 20 for monitoring fluid distribution, as illustrated in FIGS. 1-5, preferably operates according to the following description. In the main office 50, for example, customer order data is entered into account tracking means, e.g., preferably provided by an accounting system 77. The 20 accounting system 77 transfers the customer order data to dispatching means 78, e.g., preferably provided by a dispatch system, a dispatch operation, or a dispatcher. The dispatcher 78 organizes the customer orders into "runs", or individual trips for specific trucks or other heavy duty vehicles. This 25 organization is preferably based upon priority, customer location (routing), product type, and required delivery date.

When requested by the driver D, the customer order date, routing instructions, product information, and pricing information are loaded from the dispatcher 78 into the heavy duty vehicle's data storage module 36 via the RF transceivers 72, 32. The customer order date, routing instructions, and 30 product information are then loaded into the handheld data terminal 22 from the data storage module 36 associated with the heavy duty vehicle 15 via the

RF transceivers.

When the data transfer to the handheld data terminal 22 is complete, the vehicle driver D preferably is then prompted by the user interface 23 of the handheld data terminal 20 to perform an inspection of the truck 15. The 5 vehicle driver D answers a series of questions about the condition of all critical truck subsystems, and records the results by sending them to the vehicle data storage module 36 via the RF transceiver 32. The central processing unit ("CPU") 33 of the vehicle data terminal 30 then evaluates the inspection results, stores the results in the data storage module 36 thereof, and prints 10 a record over a vehicle printer 39.

If the heavy duty vehicle 15 or truck passes inspection, the vehicle driver D is prompted to load products required by the customer order. If the truck 15 does not pass inspection, the driver D is prompted to re-inspect the truck 15 after repairs have been made. As the driver D loads product, the 15 product type, the amount, and the compartment into which the product is being loaded is recorded in the data storage module 36. When the loading is completed, the bill of lading number and the supplier product identification are entered by the driver D and transferred to the data storage module 36 via the RF transceiver 32. A record is also printed over the truck printer 39.

20 The handheld data communications terminal 22 then presents the driver D with a list of customer locations to which the driver D is to deliver product. When the driver D arrives at the customer's location, the driver D selects that customer from the list, and the handheld data terminal 22 displays any special instructions for that customer. After the driver D reads 25 the instructions, the handheld data terminal 22 retrieves a list of the individual tanks 40 to be filled on the customer's order from the data storage module 36 using the RF transceivers.

The driver D is then prompted by the handheld data terminal 22 to scan a bar code 42 that has been previously placed on the customer's tank. 30 The data from the bar code reader 28 is compared to the previously retrieved list. If the scanned tank 40 is found in the list, then the handheld data terminal 22 sends the identification of the scanned tank 40 to the CPU 33

using the RF transceivers. The driver D is told which valve or valves will deliver the product to the tank 40.

If the scanned tank 40 is not found on the list, a warning is preferably posted on the display of the handheld data terminal 22. If the driver D 5 chooses to deliver the unrecognized tank 40, the scanned identification is recorded, along with product type, the amount delivered, and the time of delivery. The valves 57 preferably are continuously monitored by fiber optic channels 52. When a valve 57 is opened, the CPU 33 is notified by the fiber optic module 55 over the twisted pair network 51.

10 The CPU 33 then compares the product type of the valve 57 which was actually opened by the driver D with the product type associated with the tank 40 that was scanned. As will be understood by those skilled in the art, the CPUs or processors preferably operate various functions as described herein under stored program control, including the accounting system and dispatch 15 system as well. If they do not match, the driver D is warned by a message sent from the CPU 33 over the second RF transceiver 32 to the handheld data terminal 22, and prompted to close the improper valve 57. If the valve 57 is not closed, a warning horn is sounded by use of the horn controller 64. If the product type matches, on the other hand, the CPU 33 sends a "start 20 pumping" message over the second RF transceiver 32 to the handheld data terminal 22. The driver D is presented with a screen by the interface 23 showing the total capacity of the tank 40 being serviced and a real time display of the amount of product pumped.

The flow meters 58 preferably are also continuously monitored by the 25 fiber optic module 55 through the fiber optic channels 52. The channels 52 send data to the CPU 33 via the twisted pair network 51 associated with the vehicle 15. From there, the amount of product pumped is recorded in the delivery record on the data storage module 36 and sent to the handheld data terminal 22 via the second RF transceiver 32 to update the real time display. 30 When the driver D indicates that the delivery is complete, the CPU 33 time stamps the delivery record in the data storage module 36 and marks the tank 40 as delivered. At this time, the driver D preferably is prompted to enter the

odometer or hour meter reading associated with the tank 40, if relevant.

The driver D is then prompted to scan the next tank 40, or complete the customer transaction if the last tank 40 of fluid has been delivered. Once the customer transaction has been completed, a record of the completed 5 transaction, including pricing, is recorded and printed over the vehicle printer 39. When all of the customers have been serviced, and the driver D returns the truck 15 to the yard, the driver D initiates an "end of run" through the handheld data terminal 22. At this point, the CPU module 33 contacts or communicates with the dispatcher or dispatch system 78 over the second and 10 third RF transceivers 32, 72. The CPU 33 also requests that collected data be uploaded from the truck or heavy duty vehicle 15.

The dispatch system 78 then preferably retrieves the data from the data storage module 36 over the third RF transceiver 72. The data retrieved, for example, can include that as described previously above and can also 15 include: (1) the amount and types of product that were loaded on the truck 15; (2) the bill of lading under which the product was loaded; (3) how much product remains on the truck 15 and in which truck compartment location; (4) which customers were visited; (5) which fluid storage tanks 40 were visited; (6) the time of the visit; (7) how much product was delivered to each tank 40; 20 (8) the hour or odometer reading at each tank 40; (9) the time the vehicle driver D spent driving; (10) the time the vehicle driver D spent loading; (11) the time the driver D spent delivery product; and (12) the results of the inspections performed on the truck 15.

The following items, for example, can be monitored continuously by the 25 heavy duty vehicle 15: (1) the odometer, to detect when the truck is moving as opposed to idling; (2) The PTO's to detect when the truck is in the pumping mode; (3) the valves 57, for various operations, including monitoring improper opening; and (4) the flow meters 58, for various operations, including monitoring improper pumping.

30 The dispatch system 78 preferably stores data in a database associated therewith. The dispatch system 58 also sends the appropriate data back to the accounting system 77 through the CPU 73 for invoice

generation. The information is also available on the dispatch system 78 for report generation.

In further detail, and as illustrated in the flow diagrams, the sequence of operation for the system 20 preferably includes customer order data being 5 entered into an accounting system or order entry module. The accounting or order entry module transfers the customer order data to the system 20 database, and the dispatch module organizes the customer orders into "runs," or individual trips for specific truck/driver combinations, based on priority, customer location (routing), product type, and required delivery date. The 10 dispatcher can also enter special instructions to each customer location. These instructions will be displayed to the driver when he is at the location. When requested by the driver, the customer order data, routing instructions, product information, and pricing information are loaded from the system database into the trucks' data storage module via an RF connection 1. This 15 is accomplished by a fleet manager module.

Customer order data, routing instructions, and product information are then loaded to the handheld device from the data storage module via an RF connection 2. When the data transfer to the handheld device is complete, the driver is then prompted by the handheld device to perform an inspection of 20 the truck. The driver answers a series of questions about the condition of all critical truck subsystems, and records the results by sending them to the data storage unit via the RF connection 2. The CPU or processor module then evaluates the inspection results, stores the results in the data storage unit, and prints a record over the truck printer. If the truck passes inspection, the 25 driver is prompted to load the products required by the customer orders. If the truck does not pass inspection, the driver is prompted to re-inspect the truck after repairs have been effected.

As the driver loads, the product type, the amount, and the compartment into which the product is being loaded is entered by the driver 30 and recorded in the data storage module. When the loading is completed, the bill of lading number, and the identification of the product supplier are entered by the driver and transferred to the data storage module via the RF

connection 2. A record is also printed over the truck printer. The handheld device then presents the driver with a list of customer locations to which he is to deliver product.

When the driver arrives at the customer's location, he selects that 5 customer from the list, and the handheld device displays any special instructions for that customer. He is also prompted to enter the totalizer readings from each of the flow meters on the delivery truck. After the driver reads the instructions, the handheld device retrieves a list of the individual tanks to be filled on the customer's order from the data storage unit over the 10 RF connection 2. The driver is then prompted by the handheld device to scan the RFID transponder that has been previously placed on the customer's tank. The code from the RFID transponder, as read by the RFID reader, is compared to the codes in the previously retrieved list, and if the scanned tank is found in the list, the handheld sends the ID of the tank scanned to the CPU 15 unit over the RF connection 2, and the driver is told which valve or valves will deliver the product to the tank. If the scanned tank is not found on the list, a warning is posted on the handheld device. If the driver chooses to deliver to the unrecognized tank, the scanned code is recorded, along with the type of product, the amount delivered, and the time of delivery. The valves are 20 continuously monitored by the fiber optic channels, and when a valve is opened, the CPU unit is notified by the fiber optic unit over the twisted pair network.

The CPU then compares the product type of the valve actually opened by the driver with the product type associated with the tank that was scanned. 25 If they do not match, the driver is warned by a message sent from the CPU over the RF connection 2 to the handheld device and prompted to close the improper valve. If the valve is not closed, a warning horn is sounded. If the product type matches, the CPU sends a "start pumping" message over the RF connection 2 to the handheld device, and the driver is presented with a 30 screen showing the name of the tank being serviced, the product to be delivered to that tank, total capacity of that tank, and a real time display of the amount of product pumped.

The flow meters are continuously monitored by the fiber optic module through the fiber optic channels, sending the data to the CPU via the twisted pair network. From there, the amount of product pumped is recorded in the delivery record on the data storage unit, and sent to the handheld unit via RF

5 channel 2 to update the real time display. When the driver indicates that the delivery is complete, the CPU time-stamps the delivery record in the data storage module and marks the tank as delivered. At this time, the driver is prompted to enter the odometer or hour meter reading associated with the tank, if relevant.

10 The driver is then prompted to scan the next tank, or complete the customer transaction if the last tank has been delivered. To complete the transaction, the driver is prompted to enter the totalizer readings from each of the flow meters on the delivery truck. Once the customer transaction has been completed, a printout of the completed transaction including pricing, if so

15 opted, is printed over the truck printer. When all customers have been serviced, and the driver returns the truck to the yard, he initiates an "end of run" through the handheld device. At this point, the CPU module contacts the dispatch system over the RF connection 1 and requests that the collected data be uploaded from the truck.

20 If an emergency occurs which could lead to a fuel spill, such as the rupture of a hose or fitting, the driver can press two buttons on the handheld device marked "panic" and the system will stop all pumping by means of a relay that shuts down the pump, or in some cases, the delivery truck's engine is shut down, which in turn stops the pump.

25 The dispatch system then retrieves the data on the data storage unit over the RF connection 1. The data retrieved, for example, preferably includes the amount and types of product that were loaded on the truck, the bill of lading under which the product was loaded, how much product remains on the truck, and in which compartments, which customers were visited,

30 which tanks were visited, the time of the visit to each tank, how much product was delivered to each tank, the hour or odometer reading at each tank, the flow meter totalizer readings at the beginning and end of each customer stop,

the time the driver spent driving, the time the driver spent loading, the time the driver spent delivering product, the results of the inspections performed on the truck, and other maintenance items, such as system reset. The following items are preferably continuously monitored and recorded by the truck: the 5 odometer, to detect when the truck is moving as opposed to idling, pumps to detect when the truck is in the pumping mode, the valves for various operations including monitoring improper opening, and the flow meters for various operations including monitoring improper pumping. The dispatch system stores the information in the system's database or other memory and 10 then sends the appropriate information back to the accounting system for invoice generation. The information is also available to a reporting module for report generation.

As further illustrated in FIGS. 1-11, the present invention also preferably includes methods of monitoring and distributing fluid to customers. 15 A method of monitoring fluid distribution for heavy duty vehicles 15 preferably includes providing a first handheld RF data communications terminal 22. The first handheld RF data communications terminal 22 preferably includes a first RF transceiver for transmitting and receiving data communications and a data collection device 29 for collecting data from customer fluid delivery locations. 20 The method also includes providing a second vehicle data communications terminal 30 mounted to the at least one heavy duty vehicle 15. Each of the second data communications terminals 30 includes a second RF transceiver 32 for transmitting and receiving RF data communications. The method additionally includes providing at least one fluid storage tank 40 positioned at 25 a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle 15. The fluid storage tank 40 preferably includes a tank identifier 42 for identifying the tank 40 and adapted to be received by the data collection device 29 of the first handheld data collection terminal 22. The method further includes providing a main office data monitoring and 30 dispatching terminal 70 associated with a main office 90 for monitoring and dispatching fuel distribution data to the at least one heavy duty vehicle 15. The main office terminal 70 includes a third RF transceiver 72 for transmitting

and receiving data communications to and from the vehicle data communication terminal 30.

The method can also include collecting tank identifying data from the at least one tank 50 with the first handheld RF data communications terminal 22 and transmitting the tank identifying data to the second vehicle data communications terminal 30. The at least one tank 40 further preferably includes a tank meter 48 for metering fluid flowing to and from the tank 40 and a fourth RF transceiver 43 associated with the at least one tank 40 and responsive to the tank meter 48. The method can further include transmitting 10 metering data from the fourth RF transceiver 43 to the first RF transceiver of the first handheld data communications terminal 22, transmitting metering data from the first RF transceiver to the second RF transceiver 32 of the second vehicle data communications terminal 30, and transmitting metering data from the second RF transceiver 32 to the third RF transceiver 72 of the 15 main office data monitoring and dispatching terminal 70.

Another method of monitoring fluid distribution for heavy duty vehicles 15 preferably includes collecting tank 40 identifying data from at least one fluid storage tank 40 positioned at a customer fluid delivery location with a handheld RF data communications terminal 22, transmitting the tank 20 identifying data to a vehicle RF data communications terminal 30 mounted to a heavy duty vehicle 15 adapted to transport fluid thereon, and transmitting the tank identifying data from the vehicle data communications terminal 30 to a main office monitoring and dispatching terminal 70. The main office monitoring and dispatching terminal 70 preferably includes an RF data 25 communications transceiver 72 associated therewith for transmitting and receiving RF data communications.

The at least one fluid storage tank 40 can advantageously have a tank meter 48 for metering fluid flowing to and from the tank 40 and an RF transceiver 43 associated with the at least one tank 40 and responsive to the 30 tank meter 48. The method can further include transmitting metering data from the RF transceiver 43 to the handheld RF data communications terminal 22, transmitting metering data from the handheld data communications

terminal 22 to the vehicle RF data communications terminal 30, and transmitting metering data from the vehicle RF data communications terminal 30 to the main office monitoring and dispatching terminal 70.

Yet another method of monitoring fluid distribution for heavy duty vehicles 15 preferably includes providing at least one fluid storage tank 40 at a customer fluid delivery location. The at least one fluid storage tank 40 preferably includes a tank meter 48 for metering fluid flowing to and from the tank 40 and an RF transceiver 43 associated with the at least one tank 40 and responsive to the tank meter 48. The method also includes transmitting metering data from the RF transceiver 43 to a handheld RF data communications terminal 22, transmitting metering data from the handheld RF data communications terminal 22 to a vehicle RF data communications terminal mounted to a heavy duty vehicle 15 adapted to transport fluid thereon, and transmitting metering data from the vehicle RF data communications terminal 30 to a main office monitoring and dispatching terminal 70. The main office monitoring and dispatching terminal 70 preferably includes an RF data communications transceiver 72 associated therewith for transmitting and receiving data communications.

The method can also advantageously include collecting tank identifying data from at least one tank 40 with the handheld RF data communications terminal 22 and transmitting the tank identifying data to the vehicle RF data communications terminal 30. The method can further include transmitting the tank identifying data from the vehicle RF data communications terminal 30 to the main office monitoring and dispatching terminal 70.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.

**THAT WHICH IS CLAIMED:**

1. A system for monitoring fluid distribution for a fleet of heavy duty vehicles adapted to transport fluid, the system comprising:
  - 5 a plurality of first handheld RF data communications terminals, each of said plurality of handheld terminals including a portable housing readily adapted to be positioned in the hand of a driver of a heavy duty vehicle, a first RF transceiver connected to said portable housing for transmitting and receiving RF data communications, a first processor mounted in said housing for processing data communications, a first user interface connected to said processor and to an external surface of said portable housing for interfacing with a heavy duty vehicle driver, and an RF data collection device connected to said processor and to said portable housing for collecting RF data communications from customer fluid delivery locations;
  - 10 a fleet of heavy duty vehicles adapted to transport fluid;
  - 15 a plurality of second vehicle data communications terminals each mounted to one of the fleet of heavy duty vehicles, each of said plurality of second vehicle data communications terminals including a second RF transceiver for transmitting and receiving RF data communications, a second processor for processing data communications, and a second user interface for interfacing with a driver of a heavy duty vehicle;
  - 20 at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle, the fluid storage tank including RF tank identifying means for identifying the tank and adapted to be received by said RF data collection device of each of said plurality of first handheld data collection terminals; and
  - 25 a main office data monitoring and dispatching terminal associated with a main office for monitoring and dispatching fuel distribution data to the fleet of heavy duty vehicles, said main office terminal including a third RF transceiver for transmitting and receiving
- 30

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data communications to and from each of the plurality of second vehicle data communication terminals, a third processor connected to said third RF transceiver for processing data communications, and a third user monitoring and dispatching interface for monitoring fluid distribution data and for providing dispatching instructions from a main office user.

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2. A system as defined in Claim 1, wherein said second processor of each of said plurality of second vehicle data communications terminals comprises a central processor, and wherein each of said plurality of second vehicle data communications terminals further includes data storing means in communication with said second RF transceiver for storing data and a printer connected to said central processor for printing data.

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3. A system as defined in Claim 2, wherein each of said second vehicle data communication terminals further includes a twisted pair data communications network and data communications protecting means connected to said twisted pair data communications network for providing protective data communications in potentially explosive environments from said twisted pair network to at least one valve or at least one meter associated with said heavy duty vehicle to which said second vehicle data communications terminal is mounted.

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4. A system as defined in Claim 3, wherein said data communications protecting means includes a fiber optics data communications module, said fiber optic data communications module including at least one light emitter for emitting optical metering data and at least one light receiver for receiving the optical metering data.

5. A system as defined in Claim 4, wherein each of said plurality of second vehicle data communications terminals further comprises at least one fiber optic channel connected to said fiber optic data communications

5 module, at least one fluid delivery valve connected to the at least one fiber optic channel, and at least one meter connected to the at least one fiber optic channel.

6. A system as defined in Claim 1, wherein said second processor of each of said plurality of vehicle data communication terminals includes odometer monitoring means for monitoring the odometer of the heavy duty vehicle, engine controlling means for controlling the vehicle engine, 5 temperature monitoring means for monitoring at least one system temperature, and horn controlling means for controlling the horn of the vehicle.

7. A system as defined in Claim 3, wherein said data communications protecting means comprises first data communications protecting means, and wherein the at least one fluid storage tank further includes a fourth RF transceiver and second data communications protecting means connected to said fourth RF transceiver and at least one meter for providing protective data communications between said fourth RF transceiver and the at least one meter in a potentially explosive environment.

8. A system as defined in Claim 7, wherein said second data communications protecting means includes a fiber optic module, said fiber optic module including at least one optical emitter for emitting optical metering data and at least one optical receiver responsive to the at least one optical emitter for receiving optical metering data.

9. A system as defined in Claim 1, wherein said third processor includes accounting means for accounting customer order data, the customer order data including fluid product-type pricing; and wherein said third processor includes dispatching means for providing dispatching instruction data to a vehicle driver.

10. A system as defined in Claim 9, wherein said dispatching means includes trip delivery organizing means for organizing individual trips for predetermined ones of said fleet of heavy duty vehicles responsive to customer location, fluid product-type, and required delivery date to thereby define fleet routing instructions.

5 11. A system as defined in Claim 10, wherein the fleet routing instructions include individual vehicle routing instructions, the individual routing instructions being transmitted from said third RF transceiver to said second RF transceiver of each of said plurality of vehicle data communication terminals and being transmitted from said second RF transceiver to said first RF transceiver of each of said plurality of first handheld data communications terminals.

5 12. A system as defined in Claim 11, wherein said first processor of each of said plurality of first handheld data communications terminal includes vehicle inspecting means responsive to the individual routing instructions for providing vehicle inspecting instructions to a vehicle driver, the vehicle inspecting instructions being transmitted to said vehicle data communications terminal of a corresponding one of said fleet of heavy duty vehicles responsive to the vehicle driver.

10 13. A system for monitoring fluid distribution for heavy duty vehicles adapted to transport fluid, the system comprising:  
a first handheld RF data communications terminal including a portable housing readily adapted to be positioned in the hand of a driver of a heavy duty vehicle, a first RF transceiver connected to said portable housing for transmitting and receiving RF data communications, a first processor mounted in said housing for processing data communications, a first user interface connected to said first processor and to an external surface of said portable housing for interfacing with a heavy duty vehicle driver, and an RF data

collection device connected to said processor and to said portable housing for collecting data from customer fluid delivery locations;

15 at least one heavy duty vehicle adapted to transport fluid;

a second vehicle data communications terminal mounted to the at least one heavy duty vehicle, the second data communications terminal including a second RF transceiver for transmitting and receiving RF data communications, a second processor for processing data communications, and a second user interface for interfacing with a driver of a heavy duty vehicle; and

20 at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle, the fluid storage tank including RF tank identifying means for identifying the tank and adapted to be received by said data collection device of said first handheld data collection terminal.

14. A system as defined in Claim 13, wherein said second processor of said second vehicle data communications terminal comprises a central processor, and wherein said second vehicle data communications terminals further includes data storing means in communication with said second RF transceiver for storing data and a printer connected to said central processor for printing data.

15. A system as defined in Claim 14, wherein said second vehicle data communication terminal further includes a twisted pair data communications network and data communications protecting means connected to said twisted pair data communications network for providing protective data communications in potentially explosive environments from said twisted pair network to at least one valve or at least one meter associated with said heavy duty vehicle to which said second vehicle data communications terminal is mounted.

16. A system as defined in Claim 15, wherein said data

communications protecting means includes a fiber optics data communications module, said fiber optic data communications module including at least one light emitter for emitting optical metering data and at least one light receiver for receiving the optical metering data.

17. A system as defined in Claim 16, wherein said second vehicle data communications terminal further comprises at least one fiber optic channel connected to said fiber optic data communications module, at least one fluid delivery valve connected to the at least one fiber optic channel, and at least one meter connected to the at least one fiber optic channel.

18. A system as defined in Claim 17, wherein said second processor of each of said vehicle data communication terminal includes odometer monitoring means for monitoring the odometer of the heavy duty vehicle, engine controlling means for controlling the vehicle engine, temperature monitoring means for monitoring at least one system temperature, and horn controlling means for controlling the horn of the vehicle.

19. A system as defined in Claim 18, wherein said data communications protecting means comprises first data communications protecting means, and wherein the at least one fluid storage tank further includes a fourth RF transceiver and second data communications protecting means connected to said fourth RF transceiver and at least one meter for providing protective data communications between said fourth RF transceiver and the at least one meter in a potentially explosive environment.

20. A system as defined in Claim 19, wherein said second data communications protecting means includes a fiber optic module, said fiber optic module including at least one optical emitter for emitting optical metering data and at least one optical receiver responsive to the at least one optical emitter for receiving optical metering data.

21. A system as defined in Claim 20, wherein said third processor includes accounting means for accounting customer order data, the customer order data including fluid product-type pricing; and wherein said third processor includes dispatching means for providing dispatching instruction data to a vehicle driver.

5 22. A system as defined in Claim 21, wherein said dispatching means includes trip delivery organizing means for organizing individual trips for predetermined ones of said fleet of heavy duty vehicles responsive to customer location, fluid product-type, and required delivery date to thereby define fleet routing instructions.

5 23. A system as defined in Claim 22, wherein the fleet routing instructions include individual vehicle routing instructions, the individual routing instructions being transmitted from said third RF transceiver to said second RF transceiver of each of said plurality of vehicle data communication terminals and being transmitted from said second RF transceiver to said first RF transceiver of each of said plurality of first handheld data communications terminals.

5 24. A system as defined in Claim 23, wherein said first processor of each of said plurality of first handheld data communications terminal includes vehicle inspecting means responsive to the individual routing instructions for providing vehicle inspecting instructions to a vehicle driver, the vehicle inspecting instructions being transmitted to said vehicle data communications terminal of a corresponding one of said fleet of heavy duty vehicles responsive to the vehicle driver.

25. A method of monitoring fluid distribution for heavy duty vehicles, the method comprising the steps of:

providing a first handheld RF data communications terminal, the first

5 handheld RF data communications terminal including a first RF transceiver for transmitting and receiving data communications and an RF data collection device for collecting data from customer fluid delivery locations;

10 providing a second vehicle data communications terminal mounted to the at least one heavy duty vehicle, each of the second data communications terminals including a second RF transceiver for transmitting and receiving RF data communications;

15 providing at least one fluid storage tank positioned at a customer fluid delivery location for receiving and storing fluid transported by the heavy duty vehicle, the fluid storage tank including an RF tank identifier positioned closely adjacent the tank for identifying the tank and adapted to be received by the RF data collection device of the first handheld data collection terminal; and

20 providing a main office data monitoring and dispatching terminal associated with a main office for monitoring and dispatching fuel distribution data to the at least one heavy duty vehicles, the main office terminal including a third RF transceiver for transmitting and receiving data communications to and from the vehicle data communication terminal.

26. A method as defined in Claim 25, further comprising collecting tank identifying data from the at least one tank with the first handheld RF data communications terminal.

27. A method as defined in Claim 26, further comprising transmitting the tank identifying data to the second vehicle data communications terminal.

28. A method as defined in Claim 25, wherein the at least one tank further includes a tank meter for metering fluid flowing to and from the tank and a fourth RF transceiver associated with the at least one tank and responsive to the tank meter, and wherein the method further comprises  
5 transmitting metering data from the fourth RF transceiver to the first RF transceiver of the first handheld data communications terminal.

29. A method as defined in Claim 28, further comprising transmitting metering data from the first RF transceiver to the second RF transceiver of the second vehicle data communications terminal.

30. A method as defined in Claim 29, further comprising transmitting metering data from the second RF transceiver to the third RF transceiver of the main office data monitoring and dispatching terminal.

31. A method of monitoring fluid distribution for heavy duty vehicles, the method comprising the steps of:

5 collecting tank identifying data from an RF identification device positioned closely adjacent at least one fluid storage tank positioned at a customer fluid delivery location with a handheld RF data communications terminal;

transmitting the tank identifying data by RF communications to a vehicle RF data communications terminal mounted to a heavy duty vehicle adapted to transport fluid thereon; and

10 transmitting the tank identifying data from the vehicle data communications terminal to a main office monitoring and dispatching terminal, the main office monitoring and dispatching terminal including an RF data communications transceiver associated therewith for transmitting and receiving RF data communications.

32. A method as defined in Claim 31, wherein the at least one fluid storage tank includes a tank meter for metering fluid flowing to and from the tank and an RF transceiver associated with the at least one tank and responsive to the tank meter, and wherein the method further comprises 5 transmitting metering data from the RF transceiver to the handheld RF data communications terminal.

33. A method as defined in Claim 32, further comprising transmitting

metering data from the handheld data communications terminal to the vehicle RF data communications terminal.

34. A method as defined in Claim 33, further comprising transmitting metering data from the vehicle data communications terminal to the main office monitoring and dispatching terminal.

35. A method of monitoring fluid distribution for heavy duty vehicles, the method comprising the steps of:

5 providing at least one fluid storage tank at a customer fluid delivery location, the at least one fluid storage tank including a tank meter for metering fluid flowing to and from the tank and an RF identifying device transponder associated with the at least one tank and responsive to the tank meter;

transmitting metering data from the RF transceiver to a handheld RF data communications terminal;

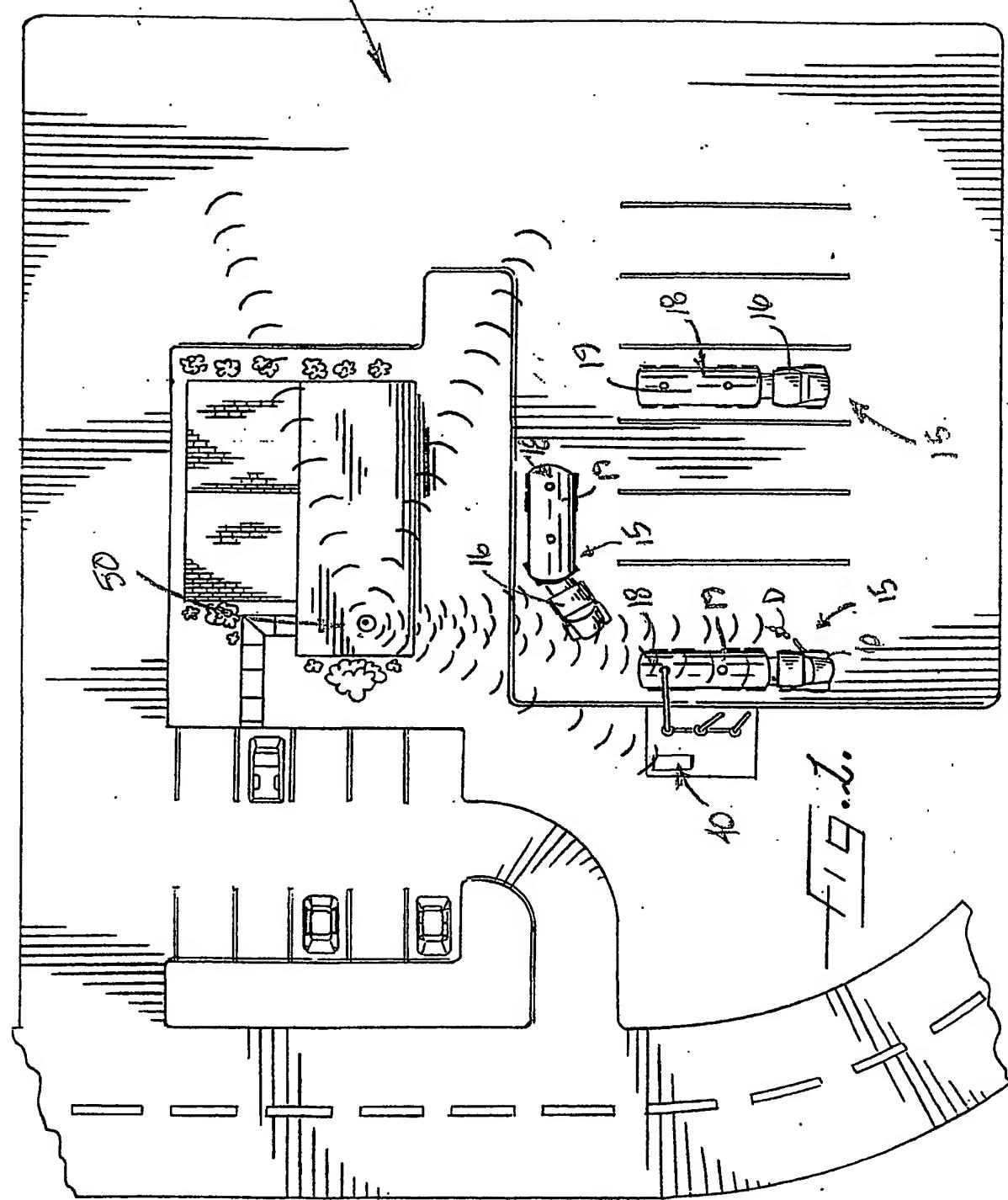
10 transmitting metering data from the handheld data communications terminal to a vehicle RF data communications terminal mounted to a heavy duty vehicle adapted to transport fluid thereon; and

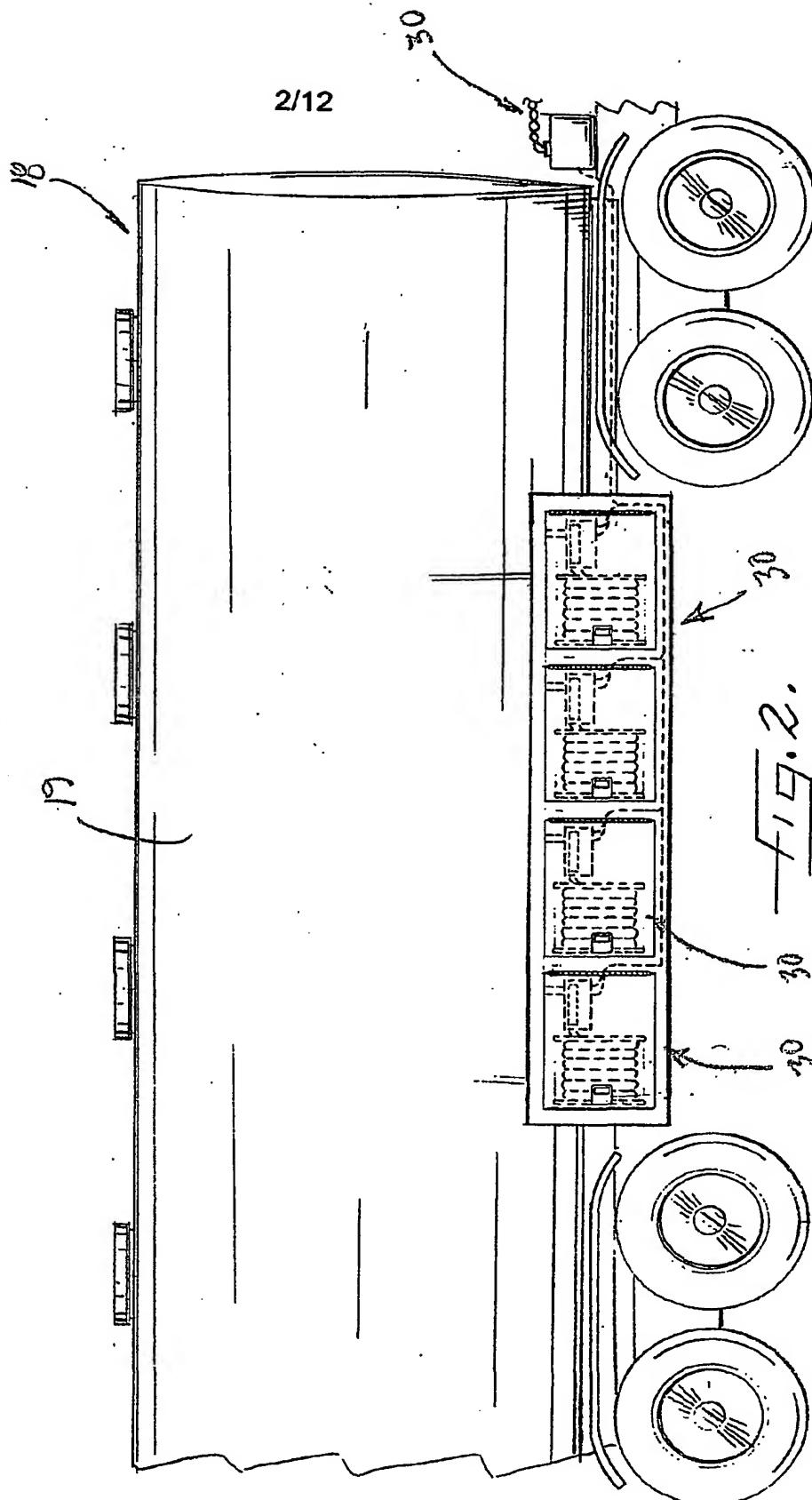
15 transmitting metering data from the vehicle data communications terminal to a main office monitoring and dispatching terminal, the main office monitoring and dispatching terminal including an RF data communications transceiver associated therewith for transmitting and receiving data communications.

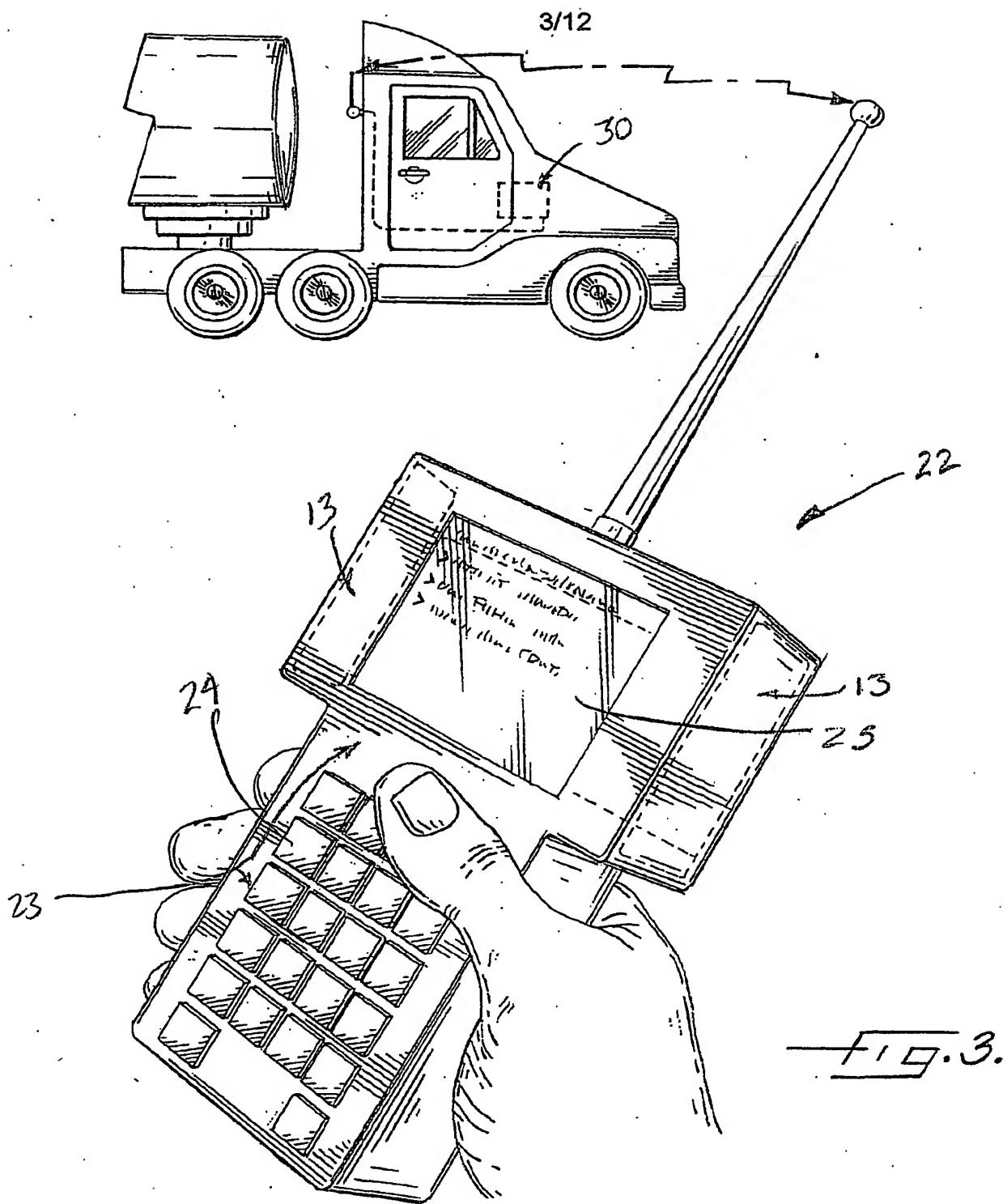
36. A method as defined in Claim 35, further comprising collecting tank identifying data from at least one tank with the handheld RF data communications terminal and transmitting the tank identifying data to the vehicle RF data communications terminal.

37. A method as defined in Claim 36, further comprising transmitting the tank identifying data from the vehicle RF data communications terminal to the main office monitoring and dispatching terminal.

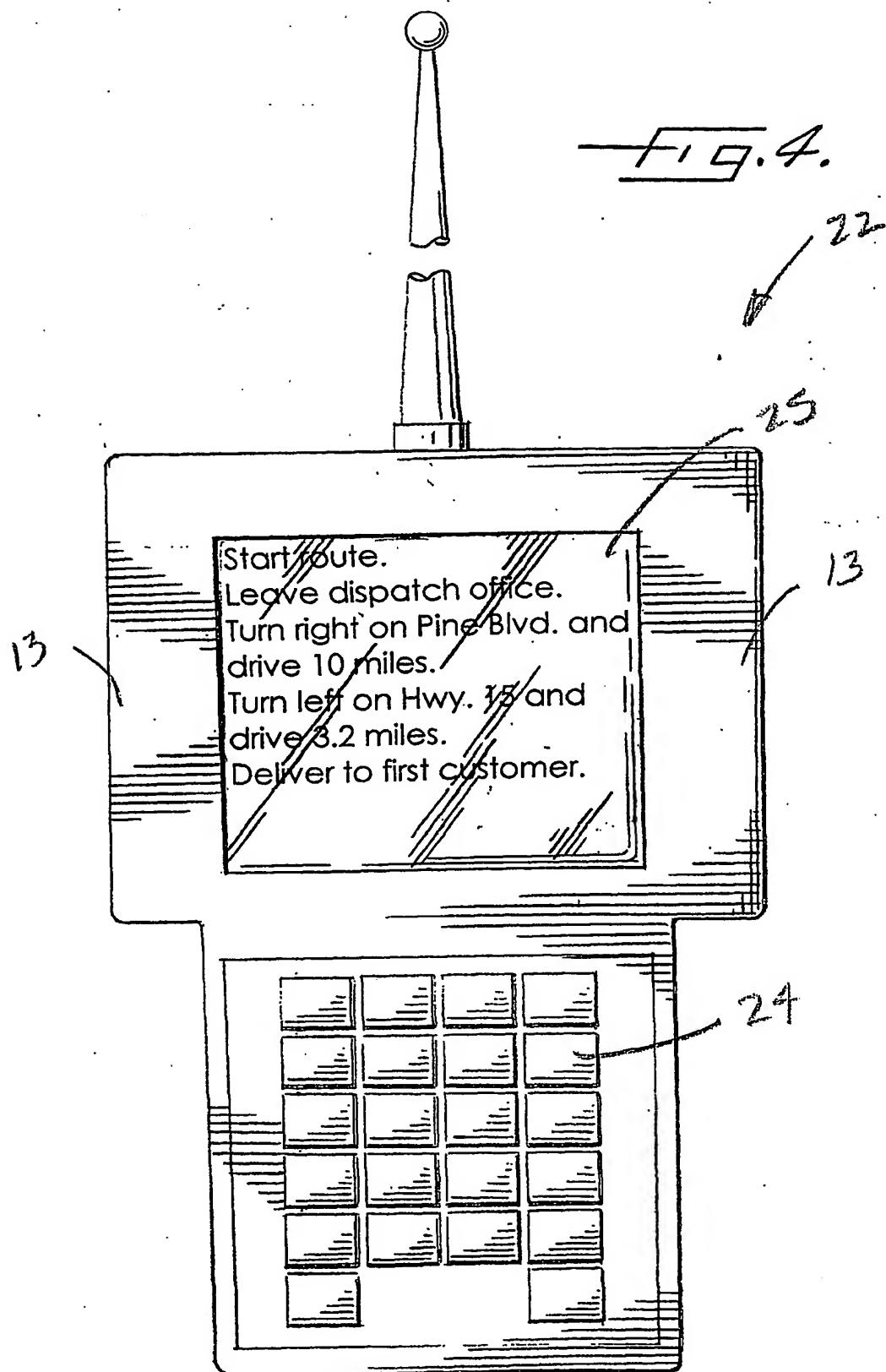
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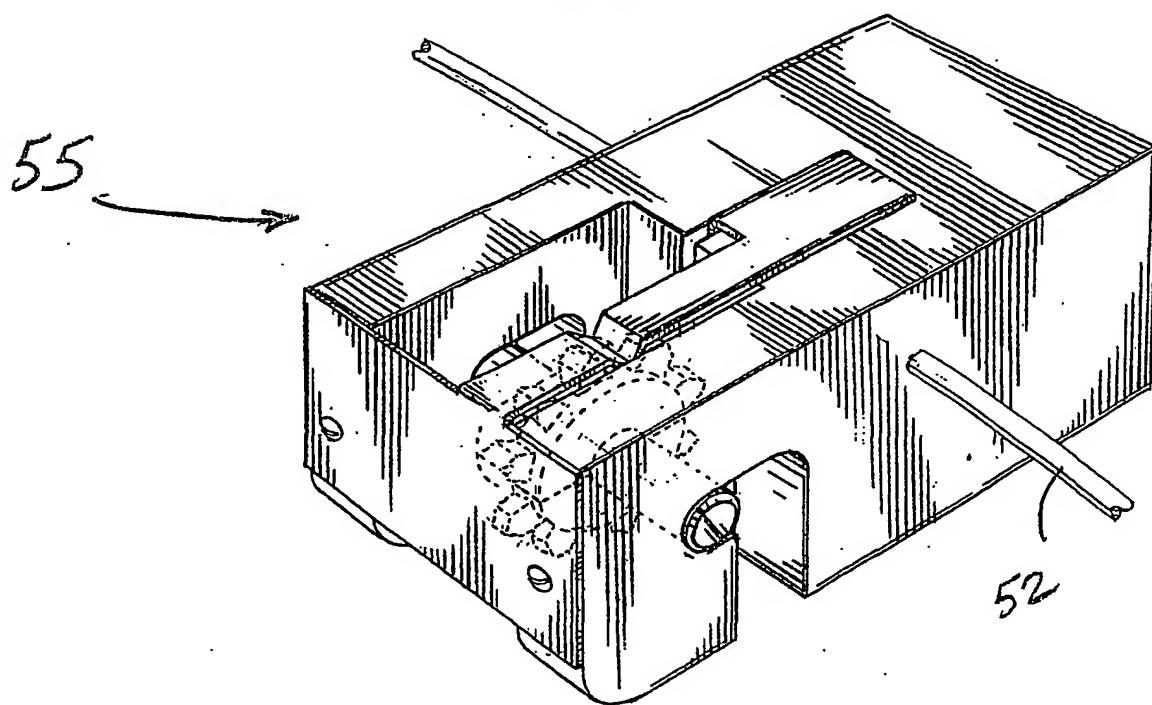


FIG. 5.

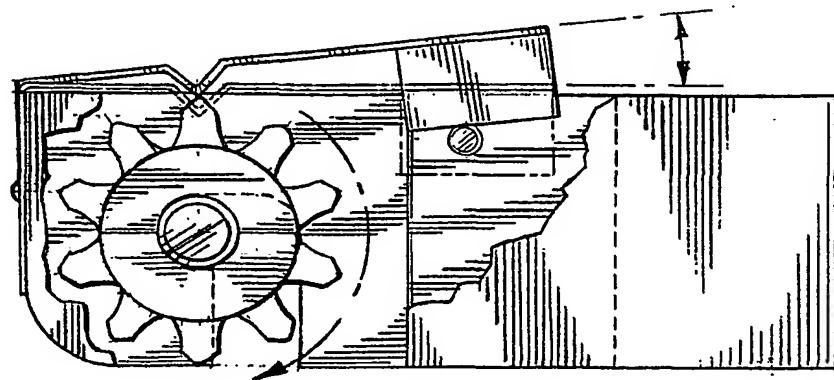
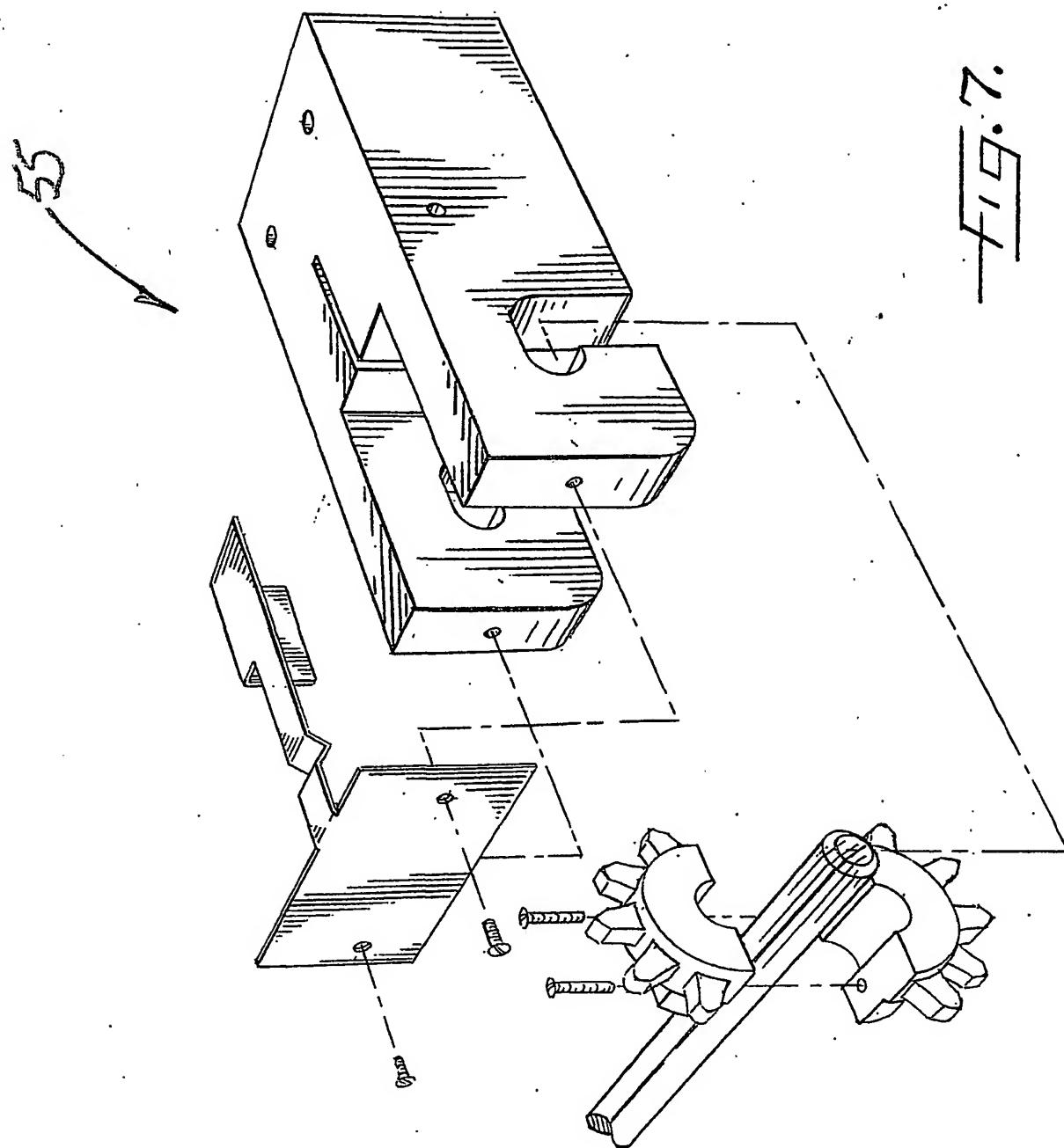
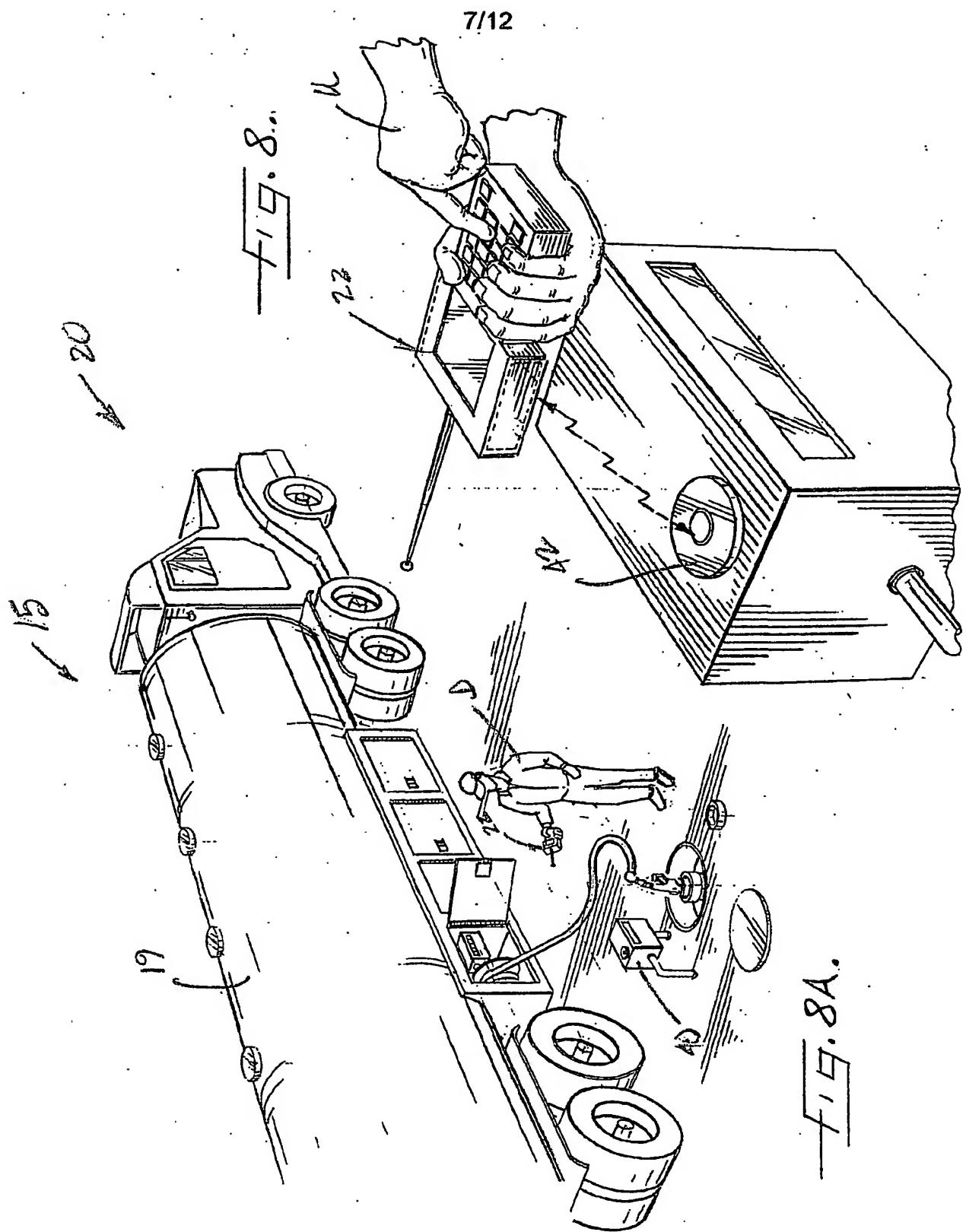


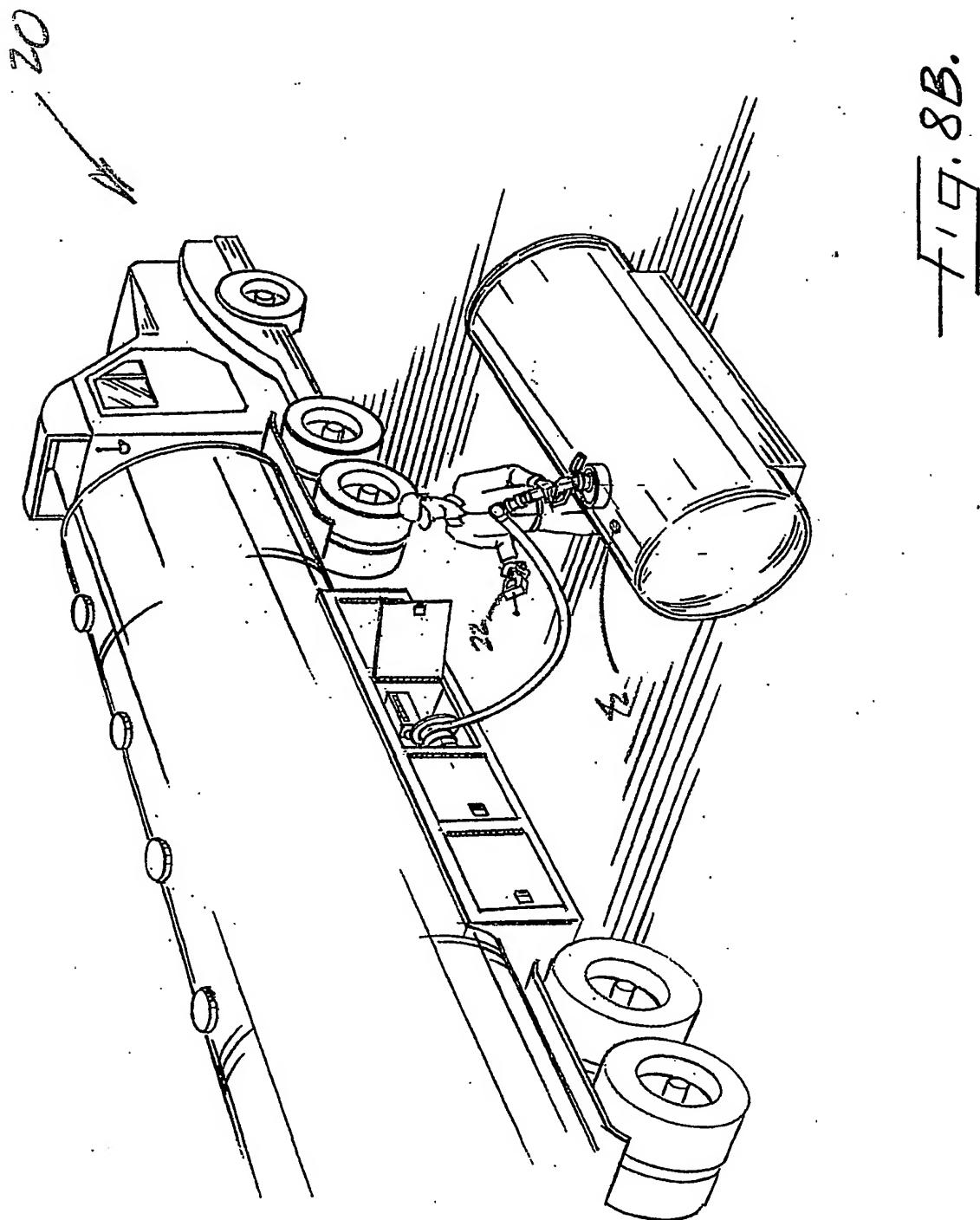
FIG. 6.

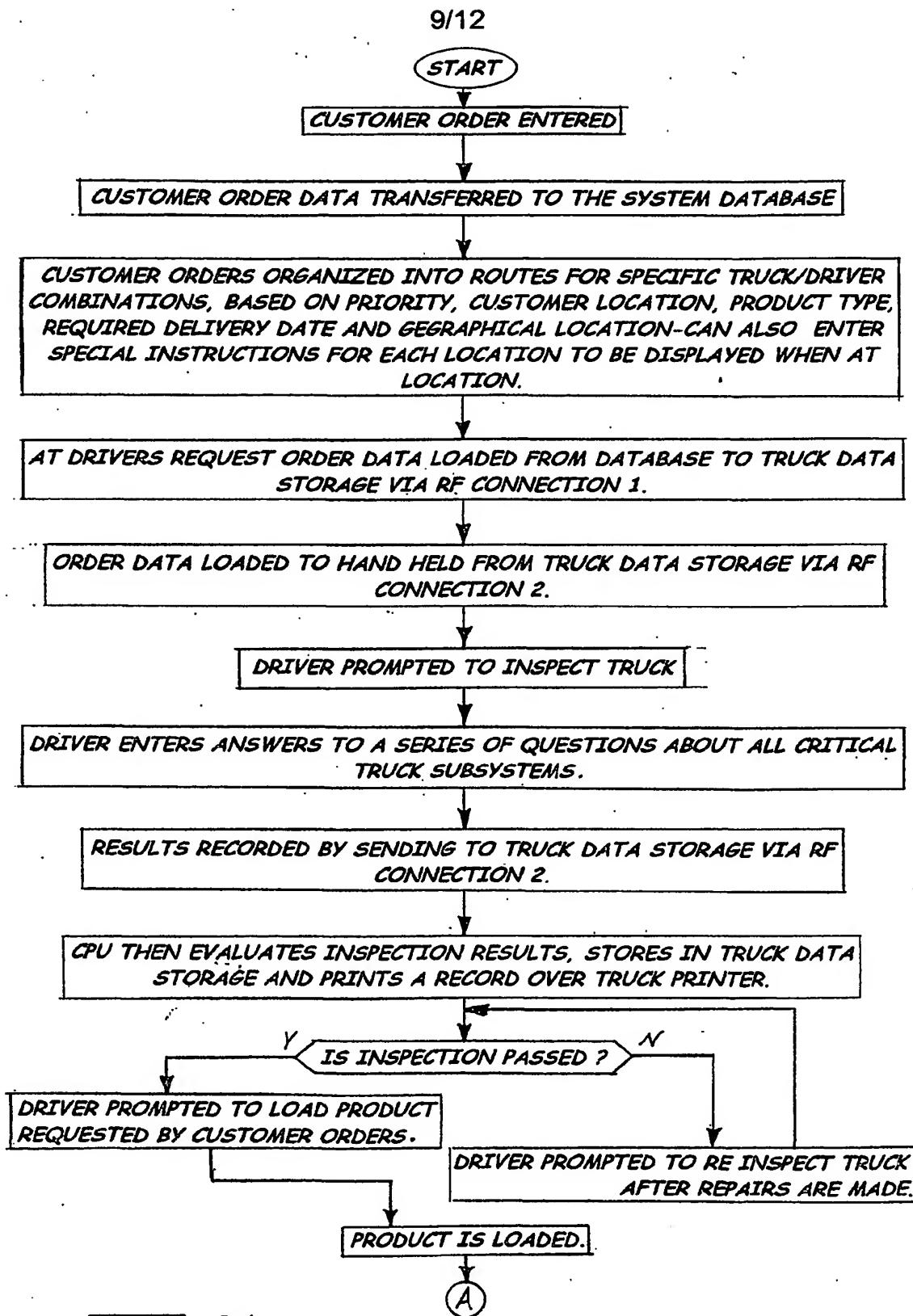
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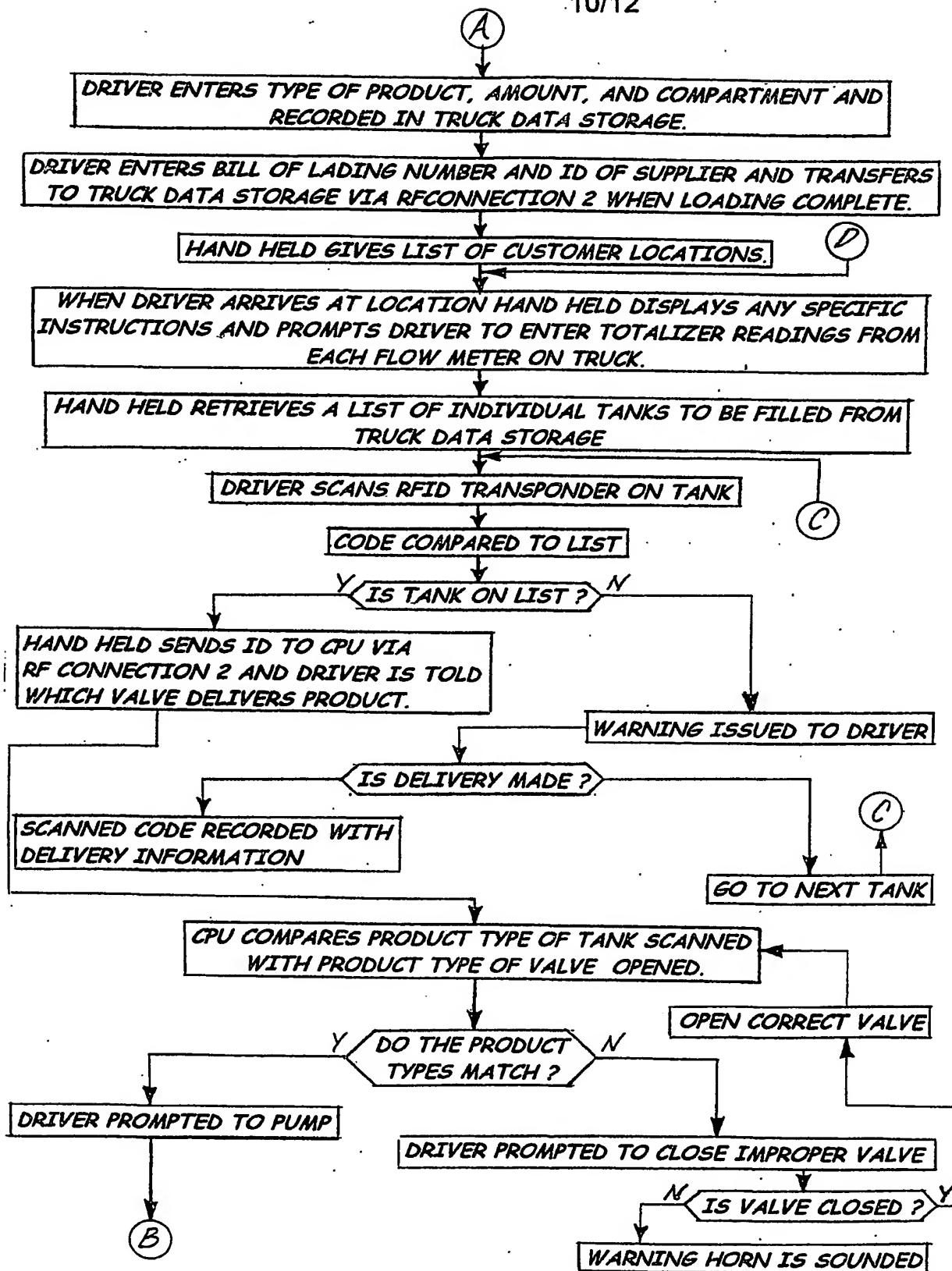
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— FIG. 9A.

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— FIG. 9B.

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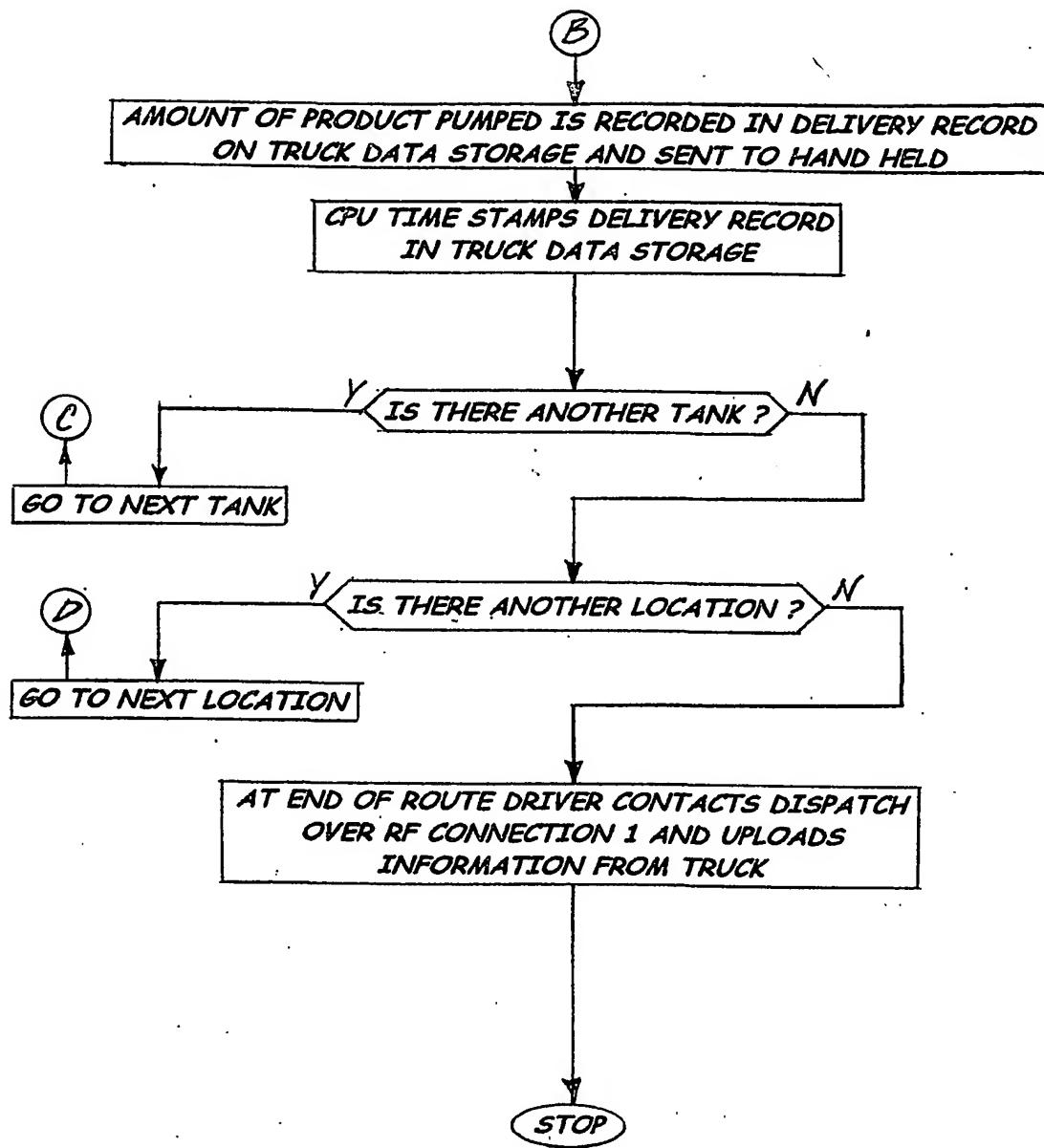
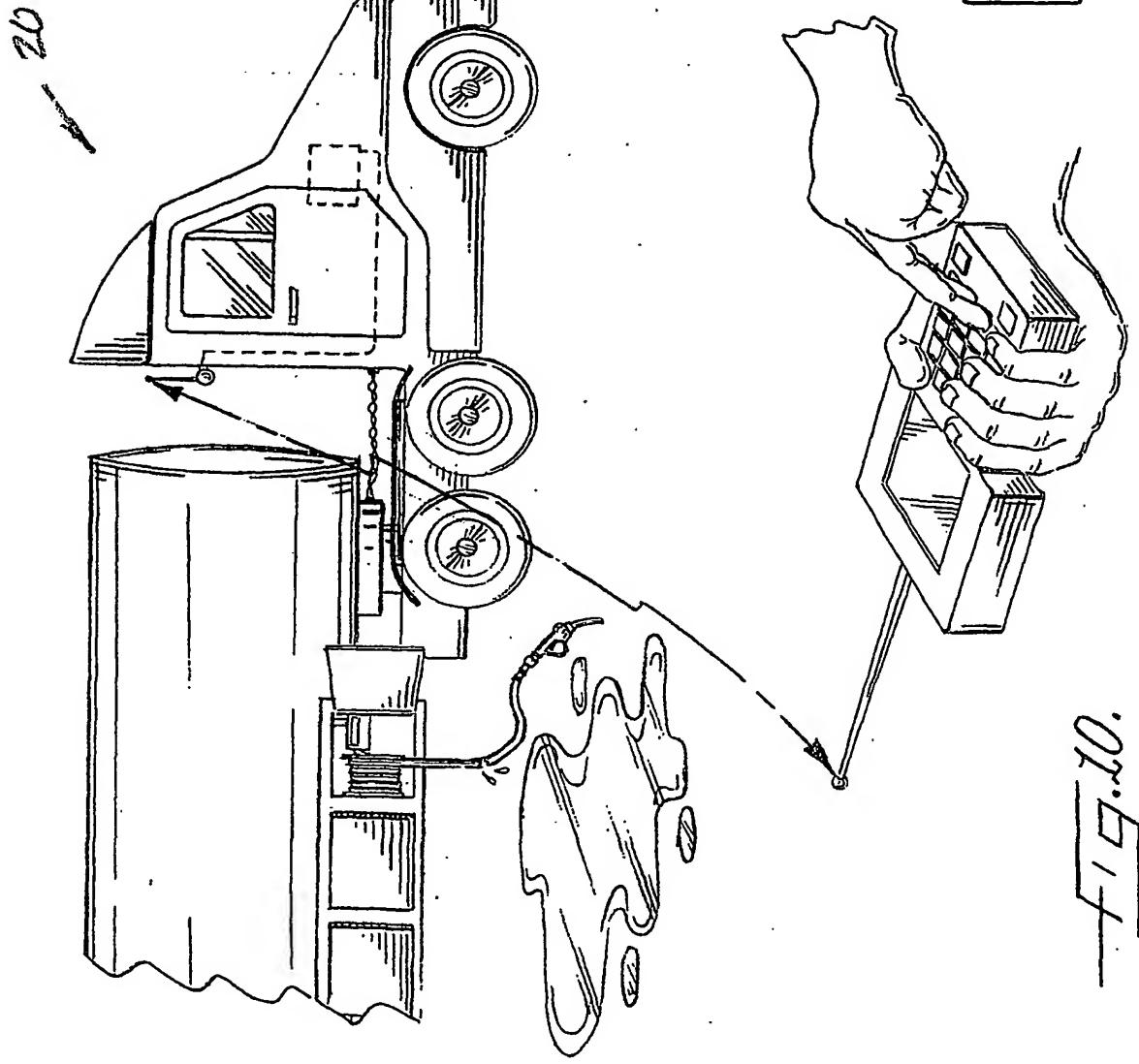
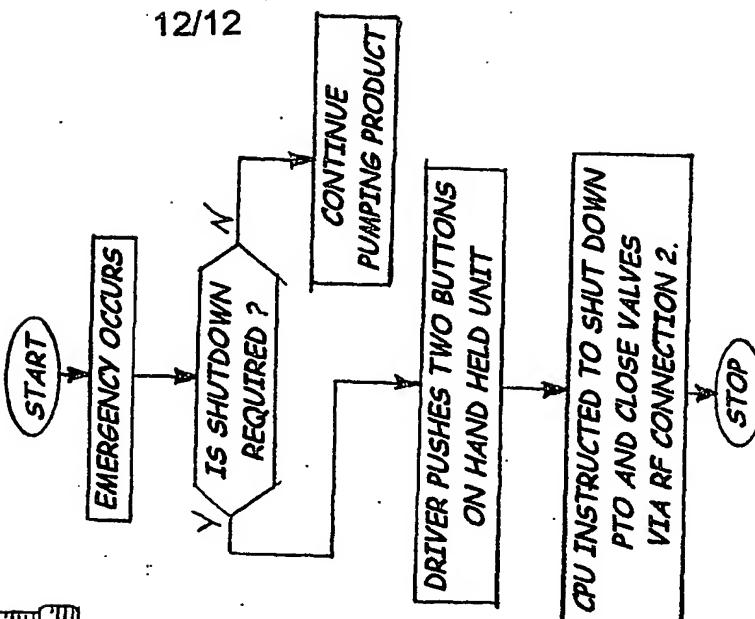


FIG. 9C.

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FIG. 11.FIG. 10.

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